Ohio Agricultural Experiment Station

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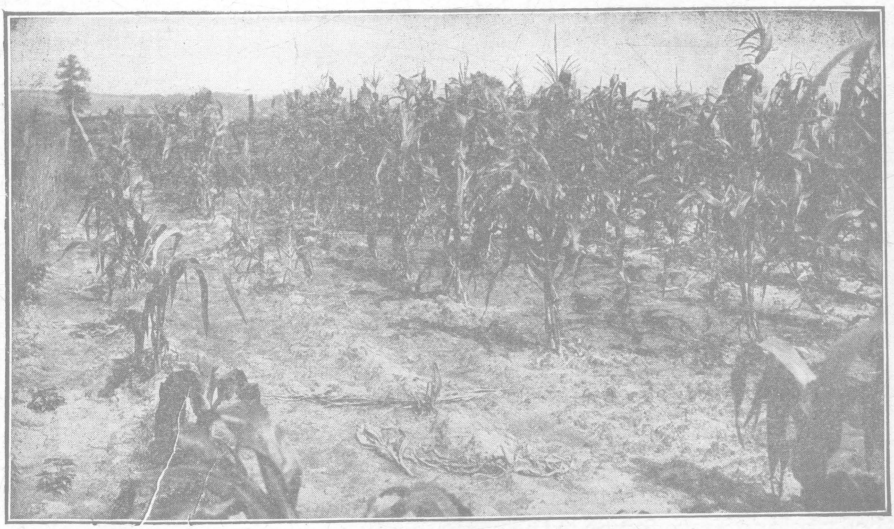
THE CHINCH BUG

Blissus leucopterus Say

By H. A. GOSSARD

For several summers Ohio has suffered to a considerable extent from drouth. Warm dry weather is favorable to chinch bug increase and several counties in the west central and northwestern parts of the State reported some damage last year. The present year has seen an extension of the infested territory and the damage in the aggregate has amounted to a large sum, though the outbreak can hardly be said to compare in severity with the worst ones known to the more western states. The light crop of wheat obtained in many fields this season was more largely due to this insect than to any other cause, though the Hessian Fly did considerable mischief in some neighborhoods, sometimes adding to the damage wrought by the chinch bug. In lesser degree, the jointworm contributed to the sum total of injury.



Outside rows of corn wilted and fallen from chinch bug attack. Photo taken about three weeks after wheat harvest.

GEOGRAPHY OF THE OUTBREAK

If the number of reports of chinch bug damage received at the Station, reinforced by inferences from statements in the letters and by some limited observations by entomological employes, can be accepted as an index to the amount of damage wrought, we conclude that the following counties are quite badly infested: Williams, Defiance, Paulding, Van Wert, Darke, Miami, Shelby, Auglaize, Hancock, Hardin, Wyandot, Seneca, Crawford, Morrow, Richland, Knox, Huron, Delaware, Ashland, Wayne, Wood, Champaign, Union, Marion, Logan; and to a lesser degree, the following: Franklin, Licking, Holmes, Stark, Jefferson, Lorain, Erie, Sandusky, Fulton, Henry, Putnam, Clark, Greene, Montgomery, Preble, Mercer and Medina. It is quite probable that some of the counties in the second list are as badly infested as the worst, and considerable damage has probably occured in some counties from which we have received no reports. If weather conditions this fall and next spring should chance to favor the increase of the insect, it seems likely that nearly the whole state will be involved and the loss may be far greater than it has been the past two seasons.

DESCRIPTION

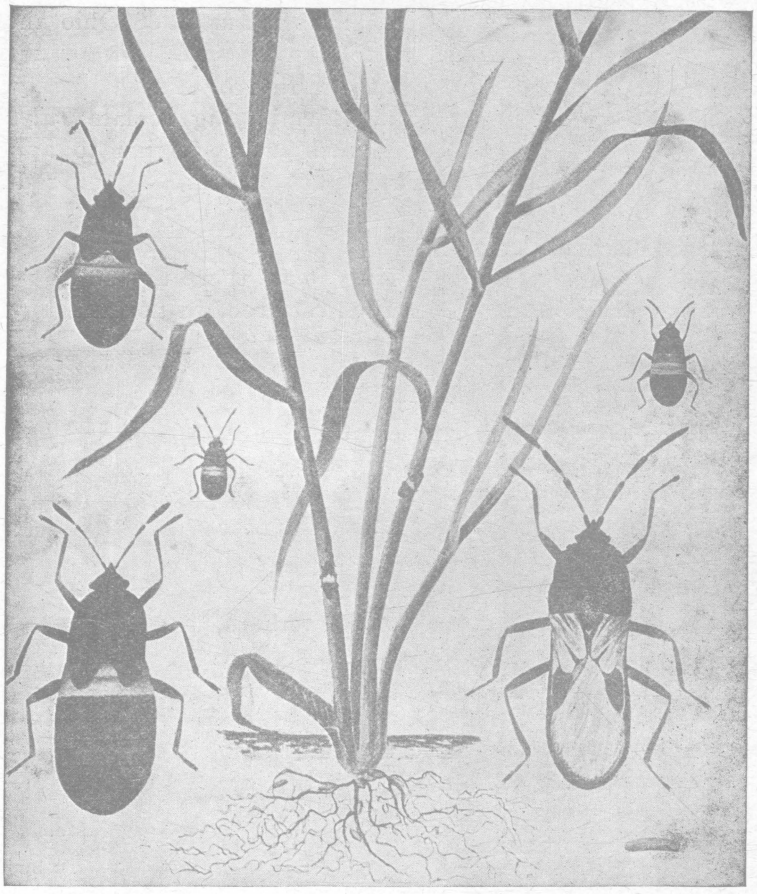
The egg is .03 inch long and elongate-oval in shape, with one end as if it were sawn flat across, and four minute projections or tubercles on the flattened end. When newly laid, the egg is whitish and partially transparent, but it shortly becomes yellowish and later distinctly reddish as the hatching time approaches.

The newly hatched *larva* is pale yellow in color, but in a short time becomes bright blood-red. After the first moult, the red becomes bright vermillion, and a pale yellowish band crosses the middle of the body transversely, The head and prothorax are rather dusky in this stage and, after the second moult, the anterior part of the body becomes blackish or dusky, and the abdomen a much duller red, the pale transverse band still remaining distinct. The wing-pads make their appearance at this time.

After the third moult, the nymph or pupa appears. This is dusky gray in color, the fore parts of the body being nearly black. The wing-pads nearly cover the pale abdominal band which still extends transversely across the body.

There are two forms of the adult or matured bugs, one having wings sufficiently long to cover nearly the whole of the abdomen, the other with much shorter wings covering hardly more than half of the abdomen and, in some specimens, less than half. The general body color of both forms is the same, black, and the insect is somewhat

hairy, the hairs also being black, while the underwings are white. The upper wings are whitish, each being ornamented with a black spot of triangular outline. The length is nearly .15 inch. The long-winged form is the more common one in Ohio, the short-winged type being rather partial to timothy, meadow and forage grasses.

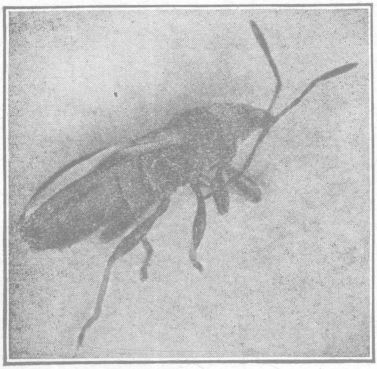


The five stages after hatching, the graded sizes showing the youngest to the mature insect. Eggs shown on the roots; much enlarged egg in lower right-hand corner. (After Forbes.)

LIFE HISTORY AND NUMBER OF BROODS

Each female is capable of laying any number of eggs up to 500 or more, with the average probably less than one-half this number. The period of egg-laying for the individual lasts from ten days to three weeks, and for the brood from five to six weeks. The eggs hatch in from twelve to twenty-two days, and the young require forty days or more to become adults after issuing from the eggs. It thus requires two months, or a few days less, to pass from the newly laid egg to the adult condition.

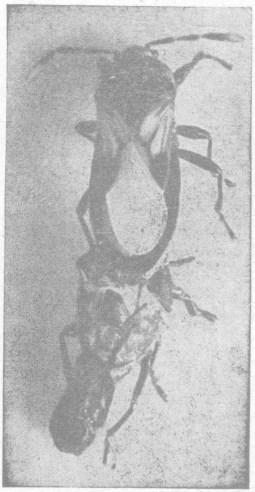
The eggs are laid on the roots of the plants on which the bugs are feeding, at or just below the surface of the ground; or they may be laid on the surface about the bases of the plants, or in the leaf-sheaths of grasses; in short, in almost any place where the surroundings are cool and damp. For most of Ohio there are two broods, the first beginning to appear in late May or early June, and terminating in late July. The second brood begins to appear in early August and is matured in the latter part of September and early October. In some seasons, and possibly in all, there appears to be only the first brood in northeastern Ohio.



Side view of adult much enlarged; shows hairiness of body

HABITS

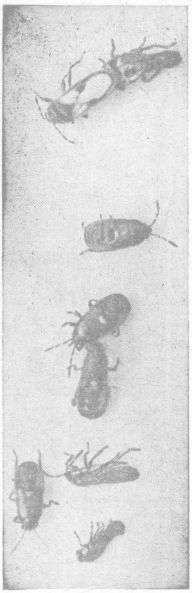
The newly hatched larvae feed on the roots of their host plants, largely underground and out of sight. If very numerous they may congregate about the bases of the plants above ground. When the wheat plants are killed at harvest, the young migrate at once in search of other sustenance and, when thus collected together in great numbers, they may blacken the entire surface of large plants, such as corn nearly grown. So insidious is their work in wheat that their presence is often unrecognized until after the harvest, when the vast hordes of insects marching into cornfields attract the farmer's notice for the first time. Timothy meadows may be well-nigh killed without the owners suspecting why they are dying. A very careful examination of the roots of timothy is needed to detect the presence of the insects, even where they are very plentiful. The second brood of bugs rarely gain attention, because they are developing under-ground on the roots of corn, foxtail, millet and other plants.



Moulting; adult bug emerging from pupal skin

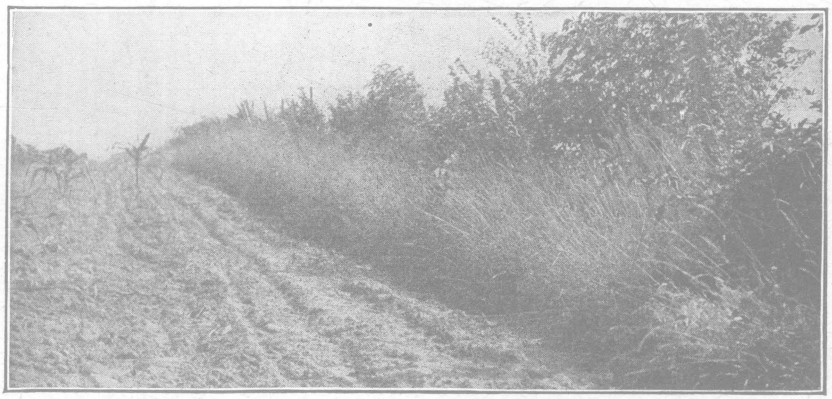
Since excessive chinch bug development and dry weather are nearly always coincident in point of time, and the bugs are so concealed from sight, the damage they do is often, perhaps generally, ascribed to the weather without investigation.

The insects cluster about the bases of the corn stalks and may prevent the development of the brace roots which keep the stalk upright, and thus in the latter part of summer, many stalks may be leveled to the ground by high winds and fail to properly mature their ears. The short-winged form is generally found in timothy meadows and on grassy land, while the cereal grains are damaged chiefly by the long-winged form.



Photograph showing nymphs and one adult just escaped from pupal skin

In late fall, about the time of Indian summer, the insects commence choosing their winter quarters, collecting in great numbers among the weeds, grass and leaves that are found along roadsides and in angles of worm fences, among the leaves lying in brush patches and woodlots, beneath shocks of corn fodder, under newly spread manure and straw, under bits of board and stones, and beneath all sorts of similar protection. They will be quiet until spring, beginning to fly about in April, unless cold weather is prolonged until late. The appearance of the insects will be scattered over several weeks and the first eggs may be laid before all of the bugs have left their winter shelters. In southern Ohio, the earliest eggs will doubtless be laid in late April in early seasons. The insects fly considerable distances and generally settle in wheat fields, the plants being of suitable age to be inviting. The bugs which later escape from their hibernating quarters, may find corn, oats or barley reaching an inviting state of development.



Where the chinch bugs delight to hide in winter. A worm-fence row, overgrown with brush, grass and weeds

These insects are sucking creatures and obtain their entire nourishment by sucking out the sap of the plants preferred by them for food.

Chinch bugs clustered at the base of corn stalks just after wheat harvest

FOOD PLANTS AND CROP PREFERENCES

Wheat is injured more than any other crop, with corn and barley not very distant seconds in the degree of expected damage. Rye is not injured so much as these, neither is oats. Millet is severely attacked, so also is Hungarian grass and sorghum. Timothy meadows which are apparently drying out, making little growth, should be examined for this insect. The short-winged form is often found in timothy. This form is incapable of flight and therefore cannot scatter rapidly. Foxtail, crab grass, bottle grass, broom corn and blue grass are all attacked, but blue grass is not a favorite food and generally escapes disastrous attack. Clover,

alfalfa, soybeans, Canada peas, cowpeas, potatoes, garden vegetables and fruiting plants of all kinds are either wholly immune, or so nearly so that the injury is neglible.

RELATION OF WEATHER TO THEIR DEVELOPMENT

A succession of dry summers, especially dry Mays and Augusts, over-lapping into June and September respectively, thus covering the two hatching periods of the insect, is very likely to induce an outbreak in a country that is subject to infestation. Yet outbreaks do not always come with such a succession of dry summers, and a single wet season may not be sufficient to overcome a bad attack; however, the worst sort of an outbreak is practically certain to subside after two or more fairly wet years. The rains carry many of the young to the ground and bury them in the mud, float others away, and compact the soil about those just beneath the surface, permanently entombing them. Wet weather also encourages the development of contagious diseases among them. They can stand almost any degree of cold, if steady, and are not necessarily killed by being frozen in the interior of ice. Alternate freezing and thawing may injure them more, but specific data regarding this question are wanting.

REMEDIES

Harvest Measures—When the insects are migrating from wheat to corn, just after the wheat harvest, resort to the following measures, so far as practicable: Have the furrows all made before the wheat is cut and a supply of road oil or tar on hand, so that nothing will need to be done when the insects commence to move, except to string the oil or tar.

With a single shovel plow make a deep V-shaped furrow around the corn fieid. Make the sides of furrow loose and dusty so that the bugs will fall back when trying to climb out. Make holes every 12 to 15 feet in bottom of furrow to catch the bugs as they crawl along the bottom. When massed in these holes pour kerosene on them or smash them with a wooden pestle. Along the inside of the furrow next to the corn, smooth and firm the bank with a hoe or roller so it will not be dusty, and with a water pot having a tubular spout, pour a slender line of road oil or fluxing oil along the hardened bank. As soon as the first line has soaked into the ground go over the line again and distribute more of the oil. The road-binding oil can generally be obtained from any representative of the Standard Oil Company. The line should be renewed every two or three days, or whenever it becomes so dried out that the bugs are able to cross

over it. Coal tar may be used instead of fluxing oil, but according to Dr. Forbes of the Illinois Station, tar is much inferior, sinking into the ground too rapidly and drying out too soon in the sun and wind. The tar barrier must be renewed about twice per day during the migrating period of the insects. A man or boy giving all his time to guarding such a barrier and keeping it in condition can care for a line 80 to 150 rods long. The tar will cost about 25 cents per day for a line 100 rods in length. The road-binding oil, according to Dr. Forbes' experiments, lasts from five to nine times as long as the tar without renewing and does not cost more than twice as much. The furrow is not very necessary, and the oil line can, in case of emergency, be poured along a level cleared space of firm ground and the post holes can be dug beside the tar line; then the bugs will be trapped almost as readily as if the holes were in the bottom of a furrow. The tar line should be on the side of the holes farthest from the approaching insects, and should barely touch the circumference of each hole, thus encouraging the bugs to move into the angle between the tar line and the circumference of the hole; they will thus prevent any retreat of the leaders and will constantly push them over the edge of the pit. The cleared strip should be about two feet wide or more and after being cleared of weeds may be made smooth and firm by dragging over it a broad, heavily-weighted plank, covered on the under surface with zinc or other smooth metal. A heavy, smooth iron roller, if not too wide, may be used instead of plank. Instead of the level strip, a back furrow may be thrown up and made firm and smooth by dragging over it an inverted, convex-bottomed trough. The tar or oil line is placed on top of the ridge thus made, and post holes are located as previously suggested. Almost any of the coal tar sheep dips may be substituted for coal tar or oil for use on a small scale, but are too expensive for use on a large scale.

If the bugs are already distributed over part of a field of corn, oats or other crop, make the barrier between the clean portion of the field and the part infested. Then spray the infested plants with kerosene emulsion diluted with 8 to 10 parts of water. The stock solution of kerosene emulsion is made as follows:

Laundry soap (chipped), ½ pound.
Kerosene (coal oil), 2 gallons.
Water (preferably soft and free from dirt particles), 1 gallon.

Dissolve the soap in the full amount of water and when this solution is boiling hot, remove from the fire and add the kerosene. Stir the mixture violently by driving it through a force pump back

into the vessel until it becomes a creamy mass that will not separate. This requires from five to ten minutes. The stock emulsion will keep good for months if kept in air-tight vessels.

Kerosene emulsion kills by *contact*, and therefore, the application should be very thorough. The quantity of materials given in the formula will make up 30 gallons of spray for use. The cost per acre for spraying will not be over $1 for the ingredients. Apply with a spray pump or in case of emergency shake over the infested plants with brooms.

Kerosene emulsion, at the dilution recommended, may not kill all of the bugs which have acquired wings, but is effective against the larvae and nymphs. Sometimes the farmer supposes, from the fact that the insects are plentiful on corn that was sprayed a day or two earlier, that no good has been accomplished, whereas most of the insects hit with the spray were killed, and new migrants afterwards took their places on the corn. Repeated sprayings may be necessary to save the outer rows of a field unless a barrier is interposed between it and the oncoming bugs.

There should be an oil or tar barrier to prevent further migration into the field as well as to protect the clean part of the field. If two or three applications of spray, a day or so apart, have eradicated the bugs from the infested part of the field, the mid-field barrier can be discontinued and attention concentrated on the outside one.

All stages of the insects are killed by pure kerosene and some farmers prefer using this drastic remedy, though it entails the sacrifice of the outer rows of corn. Again, straw is sometimes scattered at the bases of the infested rows and set on fire, burning both corn and bugs. Another method of burning them is to use a plumber's blast lamp, which, if moved rapidly up and down the stalks, will consume the bugs without necessarily doing much injury to the corn. These last mentioned measures, reduced to practice, have not been as satisfactory as the barriers of tar, oil and dust, when supplemented by spraying with kerosene emulsion.

A serviceable barrier between a migrating body of bugs and a cornfield is a strip of millet a rod or two in width. The insects will collect in this, stopping to feed as long as it survives, and when all are collected in it, plow it under to a depth of 8 or 10 inches, working from the outer borders of the strip inward, and immediately harrow and follow with a heavy roller so as to effectually bury all the insects and thus prevent their scattering over the cornfields to breed as soon as provided with wings.

Where for any reason the oil, tar or millet barriers cannot be provided, proceed as follows:

Plow up a strip of ground about ten feet wide around the infested fields, then disk and drag with brush bundles until the soil is pulverized into a fine dust. Now with a short log, from eight inches to one foot in diameter, or with a triangular trough made by nailing two boards together and then weighting with stone, make a furrow by dragging back and forth in the same track until a good ditch has been make across the line of chinch bug march. Where necessary, dress the sides of the furrow with a hoe, making sure that all slopes are even and dusty, so that the bugs will be certain to slip back to the bottom of the furrow when they attempt to ascend. With a post-hole digger make holes every 12 to 15 feet in the bottom of the ditch to catch the bugs as they crawl along the bottom. Kill bugs in the holes as previously directed. This will be a more effective dust furrow than the emergency one made with a shovel plow, previously described. If necessary, use the post-hole digger to clean out the dead bugs and keep the holes in order. Owing to rains and use, the dusty sides of the furrow may become passable to the bugs, in which case it may be renewed by dragging the brush bundle through it again, or it may be better to make a new ditch parallel with the old. In case the new ditch is made, the old may be used for a coal tar barrier if tar or oil is obtainable. The sides of the old furrow should be firmed with a hoe so dust particles will not rattle down on the tar. A slender line of tar should then be strung along the bottom of the furrow, or it may be poured along a line of hardened soil just outside the dust furrow. Remember that the tar line will always be most effective when touching the rims of the holes, and if the holes are made in the bottom of a furrow, the bugs will collect into them faster if the bottom of the furrow is kept compacted and smooth so they can the more readily travel in it. If the temperature is high in the bottom of the dust furrow, from 110° to 120° Fahrenheit, young bugs falling therein will be killed.

Fall, Winter and Spring Measures—From the paragraph on Habits, (p. 4) the reader will be able to draw the inference that either the cleanest kind of culture should prevail over the farm in late summer, all grassy and weedy borders around fields and along fence rows being kept closely mowed to prevent the development of suitable hibernation quarters, or else these should be allowed to grow vigorously so as to entice, in late fall, as many of the insects beneath the shelter as possible. In early winter, after the insects are nicely settled or else in early spring, before they have wakened into activity, burn over all such retreats. If it is impossible or undesirable to burn over woodland retreats, the leaves and trash on the ground may be collected and burned if the prospective damage by

the insects exceeds the value of the humus that would be destroyed by burning. If a bushel or so of leaves are collected and carried into a warm room, keeping them covered with cheesecloth, a day or two will determine if many chinch bugs are hidden among them, since the insects will crawl out and show themselves as soon as the chill has passed from them. The wheat stubble in young clover fields can be burned when the ground is frozen hard, without injury to the clover, but probably insufficient heat would be developed to kill the over-wintering bugs. However, with their shelter removed, it seems probable that alternate freezing and thawing might destroy many of them. Shocks of corn fodder should not be left standing in the field over winter as the bugs sometimes congregate by millions in the butts of these. If the insects are noticed under the shocks when hauling to the barn it will be well to take a spray pump and pure kerosene, or else kerosene emulsion diluted with 2 to 4 parts of water, to the field in another wagon, and spray the bugs on the ground as fast as the corn is removed. Care should be taken to dislodge all bugs from the butts of the fodder by jarring or brushing while loading. The general utilization of corn fodder shocks as traps would do much to ameliorate damage throughout a neighborhood the following season. Do not scatter manure in the fall, when chinch bugs are abundant, unless the manured field can certainly be plowed under deeply in very early spring before the insects have crawled from beneath the shelter and dispersed. After plowing, harrow at once and roll firmly to prevent any of the bugs from escaping. Do not spread barnyard manure on wheat in fall, during chinch bug invasions, for this invites almost certain destruction of the grain the following spring.

The wintered-over adults are very partial to young millet, Hungarian grass and spring wheat, and if borders of these are sown in very early spring around wheat fields, they may prove useful in intercepting many of the insects from entering the wheat and will certainly be useful in stopping the migration of the bugs to nearby cornfields after harvest. As soon as the bugs are about all collected in the grassy border, which will be in two or three weeks after harvest, plow under 8 to 10 inches deep, harrow well to cover all the bugs, and follow with a heavy roller.

If a strip of millet from 10 feet to a rod wide be sown around the borders of cornfields, about 5 to 8 weeks before wheat harvest, it will stop the bugs where they may be dealt with as already advised. Have all furrows made and holes dug and a supply of tar or oil on hand, prior to the harvest, so that nothing will be left to be done after the wheat is cut, except to string the tar.

SUBSTITUTE CROPS FOR WHEAT

If a field of wheat is so badly infested in spring that the crop is to be an evident failure, plow under deeply, harrow and roll, then plant to potatoes, Canada peas, soybeans, alfalfa or garden truck. If there is time to allow it to lie fallow for three or four weeks, after plowing, there will then be a good chance to get a silage crop of corn on it. Wheat is raised by the Ohio farmer because it is a good nurse crop for clover, furnishes straw for manure making, and ripens at a time when it can be readily cared for. After wheat, rye probably comes nearer to meeting these requirements than any other grain. It is a good nurse crop for clover, nearly equal to wheat, and fortunately, is less subject to chinch bug damage than wheat. It is a mistake to suppose that these insects are not able to ruin it, but on the average, the Ohio farmer can reasonably expect at least a fair crop of rye, even when the bugs are quite bad in neighboring wheat fields. Oats also is not greatly injured, and may be used to grow with clover. This crop is not nearly so good a clover nurse as either wheat or rye. Barley is injured less by the bugs than wheat, but ranks among the crops most likely to be damaged, and but little could be gained by substituting it for wheat. Soybeans, Canada peas, cowpeas and alfalfa are nitrogen gathering legumes, which can take the place of clover as soil builders, and they are undisturbed by chinch bugs. If it is desired to get a cover crop on oat stubble during the fall, rye may be used for this purpose, and if it is not desired as a cereal crop with clover the following year, it can be plowed under in the spring as a green manuring crop and the field planted to potatoes, oats or corn, unless full of bugs, in which case the cereal crops might be damaged unless the precautions previously suggested were carefully observed. In a bad chinch bug year, the farmer would probably do better to follow oats with oats or corn with corn than attempt to produce wheat, but some of the immune crops just suggested are much to be preferred.

THE OUTLOOK

If Ohio experiences a dry summer, and rains are light up to seeding time in late September, the odds are rather heavy against the wheat grower in chinch bug districts, especially so since the Hessian Fly is also rather numerously distributed over large areas. A wet spring, next year, might reverse the expectation and save the day, but many farmers, under such circumstances, will prefer to take smaller chances and, therefore, will not sow wheat. If, on the other hand, rains are frequent and general until seeding time in the fall, there is a fair chance to get a crop of wheat next summer. Much will depend on the rainfall next spring, during the breeding season in May and June.

NATURAL ENEMIES AND FUNGUS DISEASES

The chinch bug has but few insect enemies, and none of these make an appreciable reduction in its numbers. Among bird feeders upon the insect, the quail or bobwhite is easily the most important. This bird deserves the full protection of the law, every day in the year for a considerable period of years, because of its important services as an insect destroyer and weed-seed eater. Other Ohio species of birds on record as devourers of the chinch bug are the meadowlark, redwinged blackbird, brown thrush, catbird, house wren, horned lark and tree swallow, but the combined work of all these makes but little impression on an average outbreak. Entomogenous diseases are more important. For several seasons, we sent cultures of the disease commonly alluded to as "the chinch bug fungus" (*Sporotrichum globuliferum*) to all who applied for it. Last year our cultures seemed to possess little or no virility and would kill very few bugs in our laboratory, even when all conditions were made as favorable as possible. Owing to the prevailing drouth over nearly all the state, it seemed impossible that any good could result from sending out the disease, and since many farmers were inclined to to pin their faith entirely to it without resorting to other and more direct measures, it seemed wisest to discontinue its distribution until weather conditions indicated a possibility that it might again prove useful. This fungus is found naturally in all parts of the State, probably upon every farm, and some investigators believe that, if weather conditions are favorable, it will start up of itself about as quickly as if artificially introduced. However this may be, we are satisfied that it is a mistake to send it out during such seasons as the past six or seven summers have been. The requisite conditions for the rapid and effective development of the contagion are an abundance of moisture and an excess of bugs. Temperatures of 65 to 75 degrees Fahrenheit are very satisfactory, and growth will probably proceed without interference at all temperatures ranging between 50 degrees or lower and 95 degrees or higher. A rather subdued light is congenial, but development doubtless goes forward under all normal illuminations, except in bright sunlight, which would quite certainly be detrimental. The needful shadow for its development is furnished by the growing herbage and the decaying vegetation and litter which covers the soil. Old chinch bugs are scarcely attacked by the fungus, but the young larvae and nymphs are often swept off by millions. Bugs which have died from the disease appear as if dusted over with a fine white or greyish powder. If masses of dead bugs are found close together and powdered over in this manner, it indicates that in great likelihood they died from this disease. Some investigators who have had

wide experience with the disease are confident that artificial dissemination works more rapidly than natural, and advise collecting these diseased bugs and scattering them over fields where the bugs are apparently healthy. To get a good start from a small lot of material, collect a number of bugs, seeking out the larvae and nymphs, and put them with the diseased bugs in a tight wooden box containing a thin layer of earth in the bottom. Supply the imprisoned bugs with fresh corn stalks as often as necessary, and keep the contents of the box moist by sprinkling water over them. As fast as the bugs show evidence of disease, distribute a part of them over the fields and supply their places with fresh bugs. Keep up this operation till a goodly number of fungus-covered bugs are distributed in the worst infested areas. If by chance the boxes become foul, they should be carefully cleaned and thoroughly aired. Should we reach the conclusion that there is a probability of lending practical assistance to the farmers in hastening the work of the fungus, we will resume the distribution of the meal and beef-broth cultures. Parties having what they suppose to be the disease upon their premises can have specimens identified by sending the same to the Experiment Station.

ACKNOWLEDGEMENTS

In preparing this treatise, I have freely referred to the writings of Prof. F. M. Webster and Dr. S. A. Forbes, the two Entomologists who have given closest study to the species, but have also consulted other authorities, and practically all of the observations herein recorded and remedies here recommended have at one time or other been confirmed or tested by some of the members of our Entomological staff. Plate I is photographed from a lithographic plate by Dr. Forbes.* The other illustrations are from negatives made by Mr. Goodwin.

*Twenty-third Report State Entomologist of Illinois, Plate I.

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